

REMARKS

Applicants acknowledge that in view of the Appeal brief filed on 9/10/04, prosecution is reopened and new grounds of rejection have been presented.

Claims 1, 3-11, 13-21, 23-41 and 43-61 are pending in the application.

The Examiner rejected claims 1, 3-11, 13-21, 23-41, and 43-61 under 35 U.S.C. § 112, first paragraph. The Examiner stated that the term "deposition rate sensor" is not supported. In the Office Action dated May 31, 2005, the Examiner indicated that the reference in the Specification relating to "sensor data" does not support the term "deposition rate sensor data". Applicants respectfully disagree. Applicants respectfully assert that the term "deposition rate sensor data" is indeed supported by the Specification, which describes sensor data relating to the deposition rate as to one embodiment of the present invention. See, for example page 9, lines 14-22. When examining the term "monitored sensor data 115" in the Specification, it would be clear to those skilled in the art having benefit of the present disclosure that this data is relating to metal deposition rate. This assertion is supported by the fact that the Specification discloses that sensor data 115 is used for metal deposition rate modeling and that it is "...appropriate for the deposition processing (MDP) performed on the workpiece.100..." Therefore, it is abundantly clear to those skilled in the art that the sensor data in page 9 of the Specification is deposition rate sensor data. Further, as illustrated in Figure 7, the sensor data 115 is acquired by a monitoring tool 110 immediately following the deposition process 105. See, Figure 7. Therefore, one skilled in the art, upon reviewing Figure 7 would readily understand that the sensor data relates to deposition rate sensor data. For at least these reasons, the Specification clearly supports the term "deposition rate sensor data." Therefore, Applicants respectfully

request that the Examiner withdraw the rejection under 35 U.S.C. § 112, first paragraph and allow claims 1, 3-11, 13-21, 23-41, and 43-61.

The Examiner rejected claims 1, 3-11, 13-21, 23-41, and 43-61 under 35 U.S.C. § 112, second paragraph, as being indefinite. In the Office Action dated May 31, 2005, the Examiner indicated that the it is not clear whether the determining the deposition rate is based upon modeled dependence to the sputter target life or using actual deposition rate sensors. Applicants respect fully assert that claim 1, 3-11, 13-21, 23-41, and 43-61 are clear because the claims clearly assert that modeling the dependence of the deposition rate is based upon a target life of the sputter target. Further, the claims recited that modeling the dependence includes using deposition rate sensor data. Therefore, modeling the dependence is based upon a target life, and the modeling process includes using deposition rate sensor data. Hence, sputter target, as well as deposition rate sensor data, are involved in the modeling of the dependence of the deposition rate. Applicants further assert that there is no ambiguity in using the term "deposition sensor rate data" since, as described above, this term is unambiguous and supported by the Specification. Also, the concept of modeling the dependence of the deposition rate based upon a target life of the sputter target is also supported by the Specification. Modeling the dependence of the deposition being based upon the target life of the sputter target is self-explanatory and is explained in the Specification. For example, as to one embodiment of the present invention, the Specification discloses that "[t]he dependence of the metal deposition rate on the sputter target life may be determined by modeling, as described more fully below." See, for example Page 7, line 24-page 2, line 2. Therefore, all concepts and terms employed in the claims are unambiguous and adequately described and supported by the Specification. Accordingly, those skilled in the art would readily understand the requirements of claims 1, 3-11, 13-21, 23-41, and

43-61 of the present invention. Hence claims 1, 3-11, 13-21, 23-30, 41, and 43-61 are unambiguous and are allowable. Therefore, Applicants respectfully request that the Examiner withdraw the rejection under 35 U.S.C. § 112, second paragraph and allow claims 1, 3-11, 13-21, 23-41, and 43-61.

The Examiner rejected claims 1, 5, 6, 9-11, 15, 16, 19-21, 25, 26, 29-32, 35, 36, 39-41, 45, 46, 49-52, 55, 56, 59, and 60 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,166,783 (*Turner*). The Examiner also rejected claims 3, 4, 7, 8, 13, 14, 17, 18, 23, 24, 27, 28, 33, 34, 37, 38, 43, 44, 47, 48, 53, 54, 57, 58, and 61 under 35 U.S.C. § 103(a) as being unpatentable over *Turner* in view of U.S. Patent No. 6,217,720 (*Sullivan*). The Examiner also rejected claims 9, 10, 19, 20, 29, 30, 39, 40, 49, 50, 59, and 60 under 35 U.S.C. § 103(a) as being unpatentable over *Turner* as applied to claims 1, 2, 11, 12, 21, 22, 31, 32, 41, 42, 51, and 52. Applicants respectfully traverse this rejection. These are rejections that have been addressed by the Applicants in the Appeal Brief, which was filed on September 10, 2004. Applicants hereby incorporate the argument provided in the Appeal Brief. However, as a courtesy to the Examiner, Applicants provide their arguments in response to these rejections below.

The Examiner rejected claims 1, 5, 6, 9-11, 15, 16, 19-21, 25, 26, 29-32, 35, 36, 39-41, 45, 46, 49-52, 55, 56, 59, and 60 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 4,166,783 (*Turner*). Applicants respectfully traverse this rejection.

The present invention is directed to modeling the dependence of the deposition rate on plasma power or the deposition time based upon the target life of the sputter target. This is in contrast with *Turner* since it does not disclose modeling the deposition rate at all. *Turner*

discloses a sputtering system, in which the desired deposition rate information is inputted by an operator to calculate the required power (see col. 3, lines 30-34). *Turner* discloses that deposition rate sensors are not used to complete a feedback loop, but use the sputtering source itself. *Turner* discloses using the sputtering to allow for regulation and correction of a process (col. 3, lines 64-67). However, *Turner* does not disclose monitoring the consumption of a sputter target to determine a deposition rate, as called for by claims of the present invention.

Applicants assert that claims 1, 5, 6, 9-11, 15, 16, 19-21, 25, 26, 29-32, 35, 36, 39-41, 45, 46, 49-52, 55, 56, 69, and 60 are not anticipated by *Turner*. In the Office Action, the Examiner did not address the amendment provided in the preliminary amendment filed alongside the Request for Continuing Examination (RCE). Applicants respectfully assert that the Examiner was required to have addressed the amendments filed in the Preliminary Amendment that was filed alongside the RCE. Therefore, the Examiner erred in not addressing the amendments filed in the Preliminary Amendment. Furthermore Applicants respectfully assert that the amendments filed in the Preliminary Amendment place the claims in condition for allowance.

Applicants respectfully assert that Examiner did not address the claim amendments relating to modeling the dependence of the deposition rate, which includes using the deposition sensor data for performing the modeling of the dependence of the deposition rate to a deposition plasma power or a deposition time based upon a target life of the sputter target, which is not disclosed by *Turner*. The Applicants respectfully assert that *Turner* does not disclose or suggest all of the elements of the claims of the present invention. For example, the Examiner cites column 3, lines 22-32 of *Turner* to read upon the element of monitoring the consumption of the sputter target to determine a deposition rate, as called for by claims of the present invention.

However, *Turner* merely discloses that the deposition rate, the power consumption, and the aging characteristics may be expressed as an empirically obtained function specific to the cathode material. The age of the cathode is expressed in kilowatt hours. See column 3, lines 23-32. However, this does not relate to consumption of a sputter target to the deposition rate and modeling the dependence on the deposition rate to the target life of the sputter target. Merely disclosing the age of the cathode does not relate to the target life of the sputter target as called for by claims of the present invention.

Furthermore, in the Office Action, the Examiner makes an implication of deposition plasma power and target life from *Turner*. However, this implication is not supported by neither the Examiner's arguments, nor by the disclosure of *Turner*. The power consumption disclosed by *Turner* generally refers to the power dissipated by the excitation source, which is monitored by examining the current drawn from the cathode and the cathode-anode voltage (See col. 1, lines 42-47). *Turner* does not disclose modeling the dependence of the deposition rate to a deposition plasma power, and Applicants respectfully assert that the Examiner does not offer evidence to imply the deposition plasma power. Applicants respectfully assert that there is no disclosure or any evidence provided by the Examiner to make such an implication and it would be inappropriate in a rejection under 35 U.S.C. § 102. *Turner* discloses that the current drawn from the cathode supply is controlled in response to power dissipated in the plasma, the cumulative usage of the particular target, the pressure and the desired deposition rate. (See col. 3, lines 7-11). However, *Turner* does not disclose modeling these relationships. Furthermore, *Turner* does not disclose modeling based upon a target life of the sputter target, as called for by claims of the present invention. Therefore, the claims of the present invention are allowable.

In the present and previous Office Actions, for example, in the Office Action dated October 28, 2003, the Examiner asserted that *Turner* does not actually use the deposition rate sensors, but still discloses them. Also, the Examiner cites the sputtering source in *Turner*, which the Examiner assert may be used to provide rate information to illustrate a prior art sensor. However, Applicants respectfully assert that even though *Turner* may mention deposition rate monitors that are used to control the excitation source of the plasma discharge and/or the sputtering source, these disclosures are not enough to anticipate or suggest all of the elements of claim 1 of the present invention. For example, as explained in more detail below, *Turner* does not disclose modeling the dependence of the deposition rate on plasma power. As another example, *Turner* does not disclose modeling any parameters based upon target lives, as called for by claim 1 of the present invention. Although *Turner* refers to a deposition monitor, *Turner* does not disclose using the deposition monitor to perform any type of modeling. In fact, *Turner* discourages the use of the deposition monitor in contrast to the use of deposition sensor data to perform a modeling, as called for by the claims of the present invention. (*Turner* discloses that a deposition rate sensor is not used to complete the feedback loop of *Turner*, See col. 3, lines 64-65). Therefore, for at least the reasons cite above, all of the elements of claim 1 are not taught, disclosed, or suggested by *Turner*, and therefore, is allowable.

Turner discloses a sputtering system, in which the desired deposition rate information is inputted by an operator to calculate the required power (See col. 3, lines 30-34). *Turner* discloses that deposition rate sensors are not used to complete a feedback loop, but use the sputtering source itself. *Turner* discloses using the sputtering to allow for regulation and correction of a process (See col. 3, lines 64-67). However, *Turner* does not disclose monitoring the consumption of a sputter target to determine a deposition rate, as called for by claim 1 of the

present invention. *Turner* discloses using the power and duration of the sputtering source operation and calculating a percentage of normalized deposition rate.

Furthermore, claim 1 of the present invention calls for modeling the dependence of the deposition rate on plasma power or the deposition time based upon the target life of the sputter target. This is in contrast with *Turner* since it does not disclose modeling the deposition rate at all. The Examiner cites the chart in Figure 1 and implies that it refers to modeling of plasma power. Applicants respectfully disagree with this implication. Figure 1 merely plots a relationship between a percentage of normalized deposition rate and kilowatt-hours of operation of the cathode (See Figure 1 and col. 2, lines 35-44). This is provided to illustrate the deterioration of the deposition rate. However, this is not equivalent to modeling the dependence of the deposition on plasma power or the deposition time based upon the target life of the sputter target, since *Turner* merely demonstrates the deterioration of the deposition rate after a certain amount of kilowatt-hours.

Additionally, the Examiner equates aging of the cathode in use to "target lives," however, the "target lives" refer to the lives of the sputter targets (See col. 2, lines 10-13). Therefore, *Turner* does not call for modeling any parameters based upon target lives. Additionally, the Examiner states that the graph in Figure 1 plotting the percentage of normalized deposition rate versus the cathode operation (kilowatt-hours) can be used to imply a modeling of deposition rate to plasma power. However, the Examiner offers neither arguments nor evidence to support such a conclusion, nor is there any evidence in *Turner* to support such an assertion. Therefore, *Turner* does not disclose the element of modeling the dependence of the deposition on plasma

power or the deposition time based upon the target life of the sputter target, or using the model to modify a deposition process, as called for by claim 1 of the present invention.

Turner discloses using the desired rate specified by the operator, and using an equation in a loop to correct the power for the usage of a cathode used in the sputtering system (*See* col. 3, lines 32-38, and the equation on col. 3, line 27). *Turner* discloses that the duration of the cathode usage is then incremented, updating the kilowatt hours of use (*See* col. 3, lines 38-42). *Turner* corrects the current control of the cathode power supply and continues the loop for controlling the processing of a semiconductor wafer (*See* col. 3, lines 46-49). In contrast to *Turner*, claim 1 calls for modeling the dependence of the deposition rate on the plasma power or deposition time based upon the target life, and using the model to modify the deposition processing to approach a desired thickness. Therefore, claim 1 is not taught, disclosed, or suggested by *Turner*. Hence, claim 1 is allowable. Additionally, independent claims 11, 21, 31, 41, 51, and 61, which have similar elements that call for modeling the dependence of the deposition rate on the plasma power or deposition time based upon the target life, and using the model to modify the deposition processing to approach a desired thickness, are also allowable for at least the reasons cited above. Therefore, in light of at least the above-presented arguments, claims 11, 21, 31, 41, and 51 are also allowable.

Independent claims 1, 11, 21, 31, 41, 51, and 61, are allowable for at least the reasons cited above. Additionally, dependent claims 3-10, 12-20, 23-30, 32-40, 43-50, and 52-60, which depend from independent claims 1, 11, 21, 31, 41, and 11, respectively, are also allowable for at least the reasons cited above.

The Examiner rejected claims 3, 4, 7, 8, 13, 14, 17, 18, 23, 24, 27, 28, 33, 34, 37, 38, 43, 44, 47, 48, 53, 54, 57, 58 and 61 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Turner* in view of U.S. Patent 6,217,720 (*Sullivan*). Applicants respectfully traverse this rejection.

The Examiner does not establish a *prima facie* case of obviousness of claims 3, 4, 7, 8, 13, 14, 17, 18, 23, 24, 27, 28, 33, 34, 37, 38, 43, 44, 47, 48, 53, 54, 57, 58, and 61, at least because the prior art references (*Turner* and *Sullivan*) when combined do not teach or suggest all of the claims limitations. Accordingly, the Examiner did not meet the legal standards to reject the claims, 4, 7, 8, 13, 14, 17, 18, 23, 24, 27, 28, 33, 34, 37, 38, 43, 44, 47, 48, 53, 54, 57, 58, and 61 under 35 U.S.C. § 103(a).

The combination of *Turner* and *Sullivan* does not disclose, suggest, or make obvious all of the elements of claims 3, 4, 7, 8, 13, 14, 17, 18, 23, 24, 27, 28, 33, 34, 37, 38, 43, 44, 47, 48, 53, 54, 57, 58, and 61. The Examiner stated that the elements relating to the dependence of the deposition rate on the deposition time or inverting the deposition rate model to determine the deposition time is not disclosed by *Turner*, and uses *Sullivan* to provide such elements. However, as described above, *Turner* does not disclose methods and/or apparatus for modeling the dependence of the deposition rate on the plasma power or deposition time based upon the target life, and using the model to modify the deposition processing to approach a desired thickness, which are called for by claims 3, 4, 7, 8, 13, 14, 17, 18, 23, 24, 27, 28, 33, 34, 37, 38, 43, 44, 47, 48, 53, 54, 57, 58, and 61 by virtue of their respective dependencies. Therefore, adding the disclosure from *Sullivan* would not make-up the deficit of *Turner*.

Sullivan discloses a multi-layer sputtering method in which a controller calculates a sputtering time required for the deposition of a specified layer thickness (*See* col. 7, lines 54-57). *Sullivan* discloses a theoretical model that models deposited layer. However, *Sullivan* does not disclose modeling the dependence of deposition rate to deposition time. *Sullivan* adjusts the layer thickness in the theoretical model (*See* col. 7, lines 65-67). The Examiner states that, the fact that determining a deposition time requires a certain deposition rate equates to modeling a dependence of deposition rate on the deposition time. Applicants respectfully disagree. No evidence or argument that would support such a conclusion is provided. *Sullivan* is directed towards calculating sputtering time for deposition of specified layer thickness, deposition rates are not calculated in this context. Additionally, *Sullivan* does not disclose inverting the deposition rate model to determine the deposition time to reach a deposition rate. Therefore, for at least the reasons cited above, adding the disclosure of *Sullivan* to the disclosure of *Turner*, would not provide all of the elements of claims 3, 4, 7, 8, 13, 14, 17, 18, 23, 24, 27, 28, 33, 34, 37, 38, 43, 44, 47, 48, 53, 54, 57, 58 and 61. Therefore, in light of at least the above presented arguments, claims 3, 4, 7, 8, 13, 14, 17, 18, 23, 24, 27, 28, 33, 34, 37, 38, 43, 44, 47, 48, 53, 54, 57, 58 and 61 are allowable.

The Examiner rejected claims 9, 10, 19, 20, 29, 30, 39, 40, 49, 50, 59 and 60 under 35 U.S.C. 103(a) as being unpatentable over *Turner*, as applied to claims 1, 2, 11, 12, 21, 22, 31, 32, 41, 42, 51, and 52. Applicants respectfully traverse this rejection.

Applicants respectfully assert that the Examiner did not meet the legal standards to reject the claims of the present invention under 35 U.S.C. § 103(a), including the fact that the prior art reference (*Turner*) does not teach or suggest all the claim limitations of claims 9, 10, 19, 20, 29,

30, 39, 40, 49, 50, 59, and 60 of the present invention. The prior art reference (*Turner*) does not teach or suggest all the claim limitations of claims 9, 10, 19, 20, 29, 30, 39, 40, 49, 50, 59, and 60. Additionally, the Examiner provided no evidence to support a contention of some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art to modify the reference. Therefore, the Examiner does not establish a *prima facie* case of obviousness of claims 9, 10, 19, 20, 29, 30, 39, 40, 49, 50, 59, and 60 of the present invention.

In light of the arguments provided herein, Applicants respectfully assert that *Turner* does not disclose methods and/or apparatus for modeling the dependence of the deposition rate on the plasma power or deposition time based upon the target life using deposition sensor rate data, and using the model to modify the deposition processing to approach a desired thickness, which are called for by claims 9, 10, 19, 20, 29, 30, 39, 40, 49, 50, 59, and 60. The Examiner uses obviousness arguments to provide the element of modeling deposition rate and power using curve-fitting techniques. However, Applicants respectfully assert that the Examiner does not provide any evidence to support such an assertion. Furthermore, even if, *arguendo*, the element of modeling deposition rate and power using curve-fitting techniques were added to the disclosure of *Turner*, the deficit of *Turner* would not be compensated for since *Turner* does not disclose modeling the dependence of the deposition rate on the plasma power or deposition time based upon the target life using the deposition sensor rate data, and using the model to modify the deposition processing to approach a desired thickness, which are called for by claims 9, 10, 19, 20, 29, 30, 39, 40, 49, 50, 59, and 60. Therefore, claims 9, 10, 19, 20, 29, 30, 39, 40, 49, 50, 59, and 60 are allowable for at least the reasons cited above.

In light of the arguments presented above, Applicants respectfully assert that claims 1, 3-11, 13-21, 23-41 and 43-61 are allowable. In light of the arguments presented above, a Notice of Allowance is respectfully solicited.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Houston, Texas telephone number (713) 934-4069 to discuss the steps necessary for placing the application in condition for allowance.

Please date stamp and return the enclosed postcard to evidence receipt of this document.

Respectfully submitted,

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